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Inflorescences: Amazing diversity of exquisite floral axis architecture among flower bearing higher vascular plants

S. K. Basu[1], M. Sharma[2] and P. Zandi[3*]
[1]UFL, Lethbridge, AB, Canada; [2]University of Rajasthan, Rajasthan, India; [3]IA University; Takestan, Iran;
*email: z_rice_b@yahoo.com

Flower, the primary reproductive body of higher vascular plant members (angiosperms) is actually a modified stem with limited growth (Chamovitz, 2002). The arrangement of the flowers on the floral axis is termed inflorescence (Dutta, 1995). The stem carrying the inflorescence is termed peduncle; while the primary axis constituting the flowers within the inflorescence is called rachis. The pedicel is the stalk of individual flower within an inflorescence and individual flower within an inflorescence is termed florets. For example the ray florets and disc florets constituting the Capitulum inflorescence among the members if the sunflower family (Asteraceae). Parallel mutation in floricaula, centrora-dialis and cycloidea genes are primarily responsible for evolution of different type of inflorescences (Coen and Nugent, 1994). Inflorescence is required for the purpose of efficient breeding and multiplication through different modes of pollination such wind, air, water and biological agents (Buhner, 2002).

Centripetal: It has monopodial (racemose) growth. In this type lowest flowers open first but main stem continue elongate. Example: all indeterminate inflorescences

Centrifugal: It has sympodial (cymose) growth. In this type terminal flower open first, rest lateral flowers developed later. Example: most of determinate inflorescences

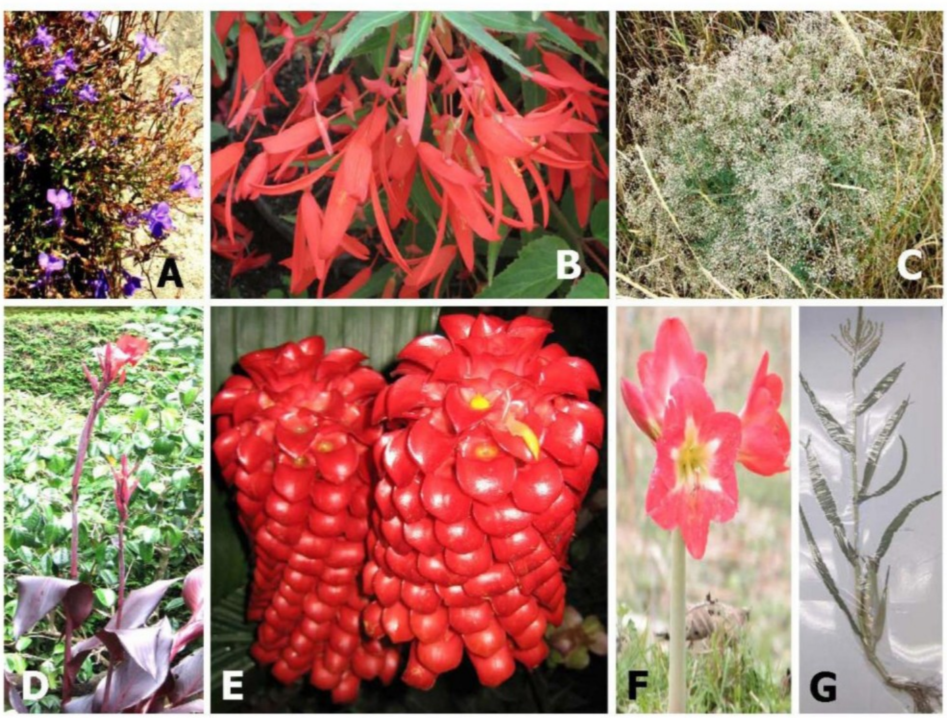


Fig 1. Spectrum of inflorescence diversity across different angiosperm families. Photo credit: S. K. Basu

On the basis of branching pattern inflorescences are of two types:

1. **Unbranched or simple**:

Indeterminate inflorescences or Racemose

Solitary: Single flower attach to a acaulescent stem. Example *Petunia*

Raceme: Unbranched, indeterminate inflorescence with pedicillate flower along the axis. Example: *Caesalpinia pulcherrima, Antirrhinum,*

Spike: Same as raceme but its flower has no pedicel. Example: *Achyranthes aspera.* Spike could be elongated or condensed.

Spikelet: Small/secondary spike with variable number of small flowers, mostly wind pollinated, each enclosed by one or two scaly bracts. Example: Characteristic inflorescence of *Poaceae* (grasses) and *Cyperaceae* (sedges) members.

Corymb: Flat topped or raceme, all pedicles reaching same level to make convex indeterminate cluster Example: *Crataegus* (hawthorn).

Umbel: It can be determinate or indeterminate. It is also flat topped but pedicels originate from same point. Example: *Allium cepa* in general *Apiaceae* (carrot family) members.

Spadix: It is characteristic inflorescence of the Aracaceae family in which densely arranged small flowers on the spike are imbedded in a highly specialized leafy or fleshy bract termed spathe. Example: *Aracaceae* (palm family/Palmae) members.

Capitulum: Inflorescence is the collection of numerous florets organized on a central platform called receptacle with two distinct floret types- the central disk (tubular) florets and peripheral ray (ligulate) florets. Example: Characteristic inflorescence of the *Asteraceae* (sunflower family) members.

Catkin or Ament: Spike of apetalous unisexual flower known as ament. Example: *Acalypha hispida*, Fagaceae members.

Glomerula: It is a dense cluster of sessile or subsessile flowers.Example: *Cornus florida*

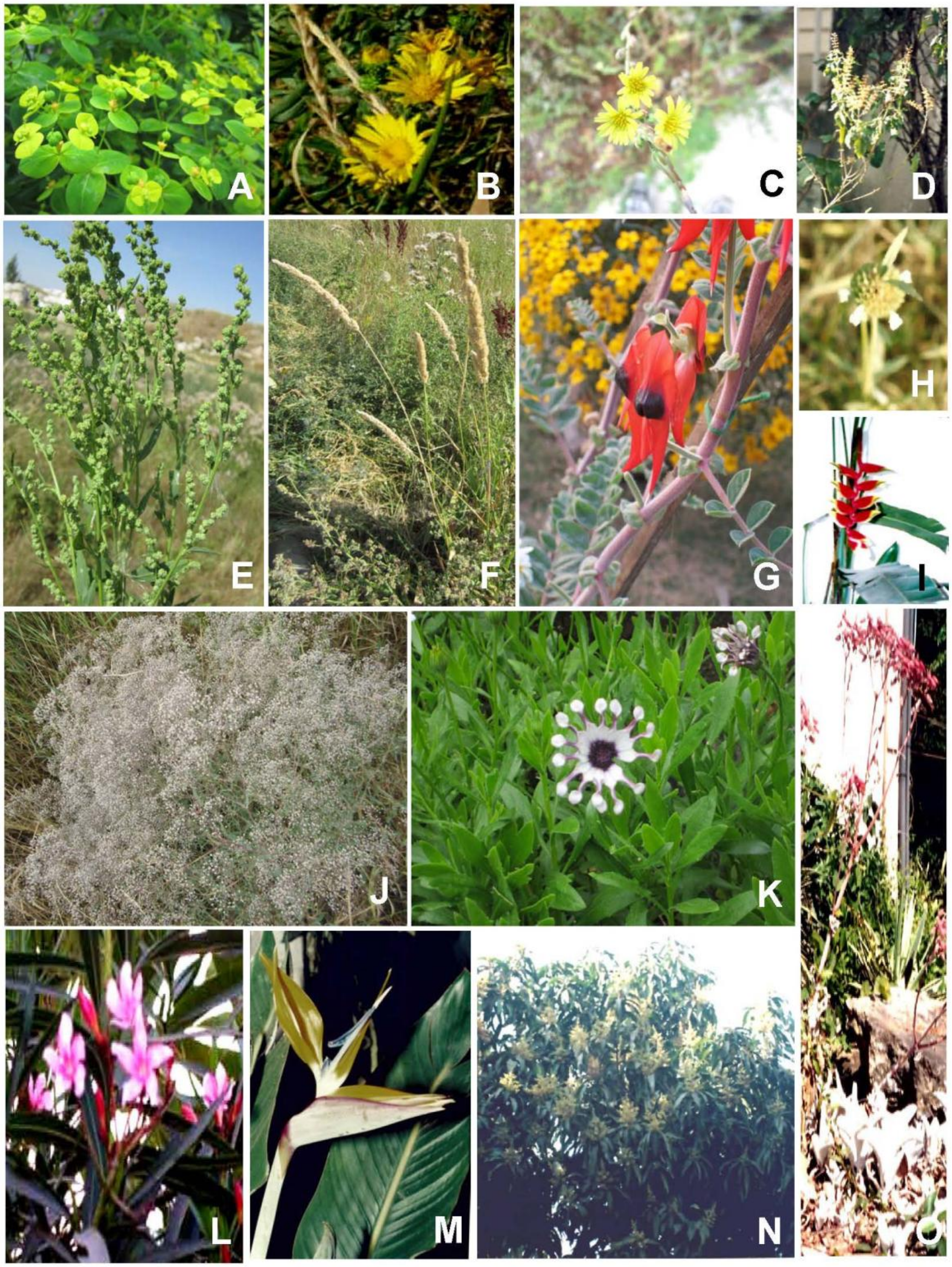


Fig 2. Different inflorescence types. A: Cyathium; B-C: Capitulum; D & H: Verticillaster; E: Highly condensed spike; F: Spikelet; G: Solitary Axillary; I & M: Spathe; J. Dichasial Cyme; K: Solitary Terminal; L: Polychasium; N: Dense panicle of numerous minute flowers at branch terminals; O: Branched Peduncle. Photo credit: S. K. Basu

Determinate inflorescences or Cymose

Monochasium:

Helicoid cyme:
In this type flowering branch gives rise to only one lateral branch, hence it form helicoid inflorescence. Example: *Hamelia patens, Heliotropium indicum.*

Scorpioid cyme:
It is zigzag inflorescence in which flowers alternately developed on opposite sides of the rachis. Example: *Rhipidium*

Dichasial cyme: In this type, the inflorescence constitutes three flowers with a central older flower being encircled by two adjacent younger flowers. Example: *Caryophyllaceae.*

Polychasium: In this type oldest flower is in the center which is surrounded by more than two flowers from lateral side and below. Example: *Nerium.*

2. **Branched or compound**

Panicle: Compound or branched raceme is known as panicle. Example: *Lagerstroemia indica*.

Compound umbel: Each flower is replaced by a smaller umbel of flowers. Example: *Crithmum maritimum.*

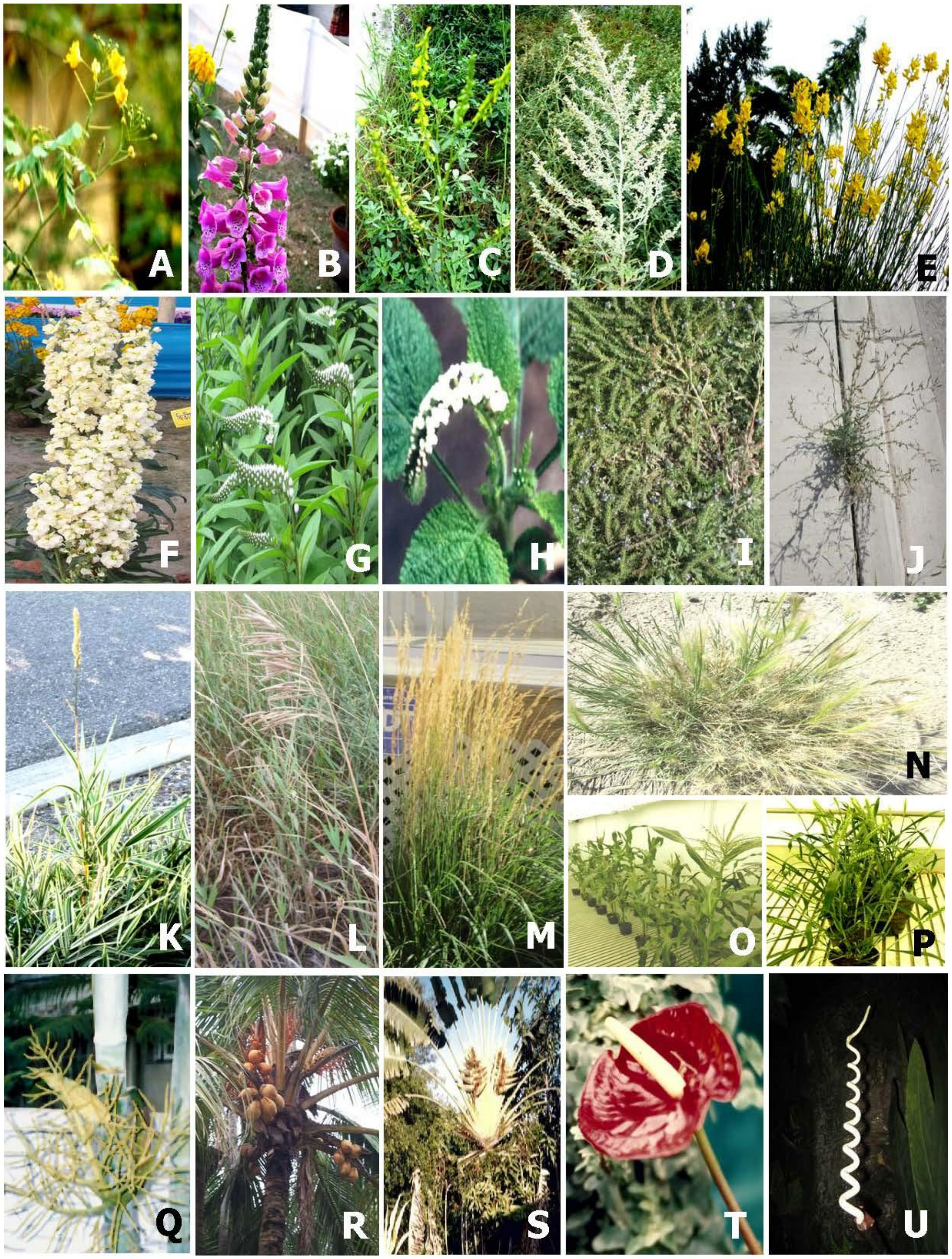


Fig 3. Different inflorescence types. A, B & E: Raceme; C-D & J: Compound Raceme; F: Condensed Spike; G-H. Monochasium; I: Spike; K-P: Spikelet inflorescences among different members of grasses (Poaceae); Q-R: Spadix; S: Spathe with flowers subtended by green bracts; T-U: Spathe. Photo credit: S. K. Basu

3. Mixed Inflorescence

Umbellate cyme: Dichasium is succeeded by monochasia. Example: *Allioideae* members.

Determinate raceme: Raceme type with terminal flower. Example: *Rubus* (blackberry).

4. Specialized inflorescences

Thyrse: Cluster of dense flowers in which lateral branches terminate in cymes. Example: *Lilac*.

Verticillaster: Flowers arranged in whorls around a common axis. Example: *C*haracteristic inflorescence of the members of *Lamiaceae.*

Involucre: One or more whorls attach at the base of the inflorescence. Example: *Artichoke.*

Cyathium: Reduced inflorescence. In this type five bracts fuse to form cup shaped receptacle. On the surface of cup nectar secreting gland usually present. Example: *Euphorbia.*

Hypanthodium: Fleshy receptacles forms ball like structure with cavity inside, this cavity opens outside with apical side. Example: *Ficus.*

Coenanthium: Inflorescence with flat receptacles with slightly upcurved margins. Example: *Dorsteni.*

Pseudanthium: Small cluster of many ray and disc flowers form a single flower like structure hence it is also called as false flower. Example: *Asteraceae*



Fig 4. Different inflorescence types. A. Solitary Terminal; B & E: Solitary Axillary; C: Double Cyme; D. Compound raceme; F. Polychasium; G, Catkin; H: Axillary/Loose Axillary Cymose; I-J: Corymb; K-L: Umbel; M-N: Capitulum; O: Spike/Panicle; P. Hypanthodium; Q: Cyathium; R. Verticillaster. Photo credits: S. K. Basu

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